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(71) Applicant
Imperial Chemical
Industries PLC
Imperial Chemical House
Millbank
London SW1P 3JF

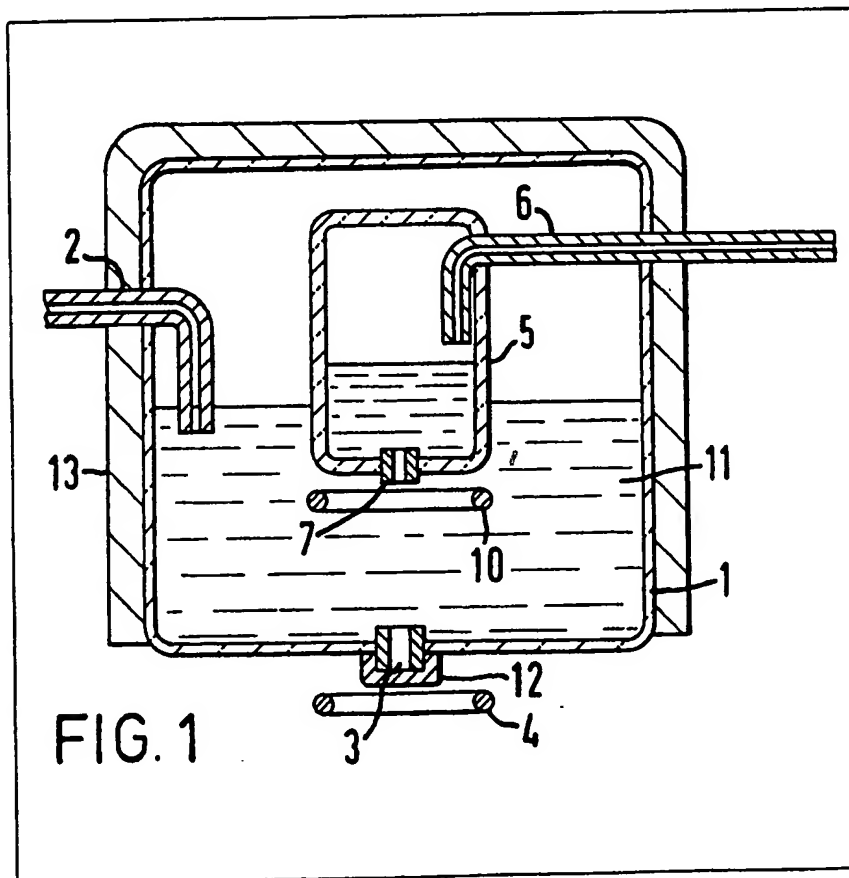
(72) Inventor
Ronald Alan Coffee

(74) Agents
Imperial Chemical
Industries PLC
Timothy Wace Roberts
Legal Department
Patents
Thames House North
Millbank
London SW1P 4QG

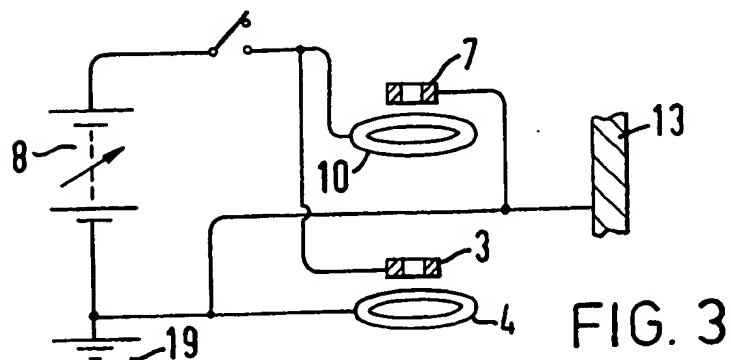
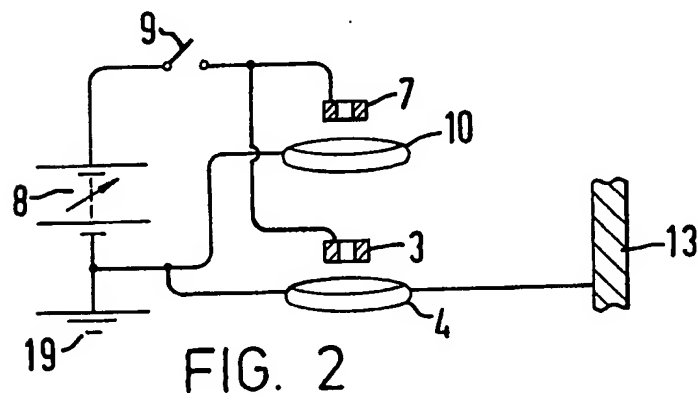
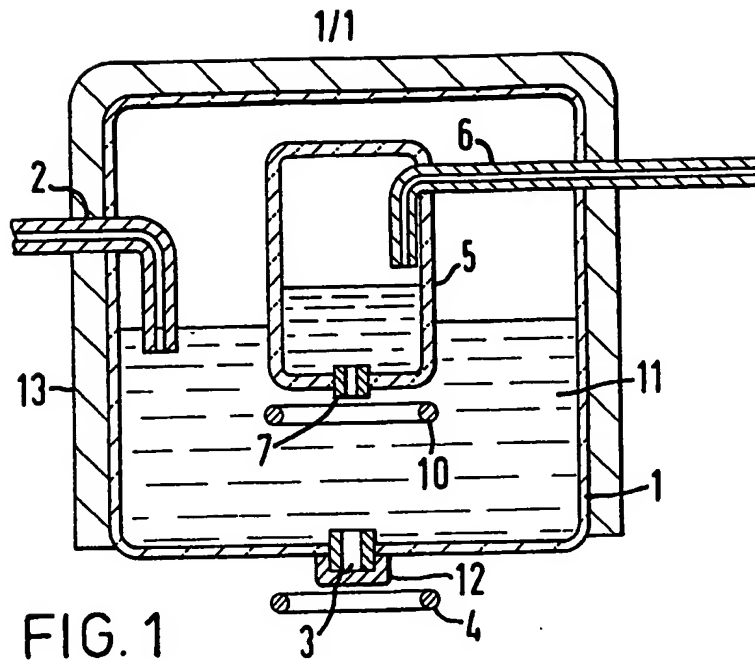
(54) Spraying emulsions

(57) A method of forming and spraying emulsions of two immiscible liquids comprises introducing amounts of highly charged disperse phase for insulating container 5 through charged metallic nozzle 7 into a body of continuous phase followed by direct electrostatic spraying of the charged emulsions so formed from charged nozzle 3. A metallic ring 4 downstream of the nozzle 3 is earthed. The disperse phase may be an aqueous solution of a pesticide and the liquid in the outer container 1 be a hydrocarbon.

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SPECIFICATION

Spraying emulsions

- 5 This invention relates to spraying emulsions. More particularly, it relates to new processes for forming emulsions and spraying the emulsions so formed, and to apparatus therefor.

10 An emulsion consists of small particles (generally of mean diameter in the range 0.1 to 10 microns) of a first liquid dispersed in a second liquid immiscible therewith. For example, an emulsion may be formed of finely divided particles of oil in water; or conversely, 15 of finely divided particles of water in oil, the latter being commonly referred to as an invert emulsion. An emulsion is a two-phase system; the particles constitute the disperse phase, while the medium in which they are suspended is the continuous phase. The properties of emulsions naturally depend on the properties of the two phases, their relative proportions and the particle size of the disperse phase. Dilute emulsions, containing for 25 example up to 10% or so of disperse phase, generally have, for example, a viscosity not dissimilar from that of the continuous phase; but increasing the proportion of the disperse phase leads to thickening, and the formation of immobile, scarcely pourable systems. The 30 present invention is concerned with relatively dilute emulsions, not too thick to be able to flowlike liquids.

35 Emulsions have a variety of uses; for example in the food and pharmaceutical industries. Cosmetics may be formulated as emulsions, and so also may pesticides. The present invention relates to emulsions to be used as sprays.

40 Emulsions are generally formed by thoroughly agitating the two phases together, for example in a high shear mixer. This is a relatively inefficient process, consuming unnecessary energy. Moreover, emulsions so 45 formed are not necessarily stable, and may break down into separate bulk phases on storage. The present invention provides a more efficient method of forming emulsions, not dependent on mechanical mixing, and 50 which prevents emulsion break-down by reducing or eliminating storage time.

According to the present invention we provide a process for forming an spraying a 55 dilute emulsion of a first liquid in a second liquid immiscible therewith, which comprises passing small amounts of the first liquid into a body of the second liquid while electrically charging the first liquid relative to the second liquid to a potential sufficient to cause emulsi- 60 fication therein, and atomising the charged emulsion thereby formed. Such atomisation may be carried out wholly or partly by mechanical means, but conveniently it may be effected by passing the charged emulsion into 65 a region of high electrical field strength

thereby causing it to atomise.

The invention further comprises apparatus for forming and spraying an electrically charged emulsion of a first liquid in a second 70 liquid immiscible therewith which comprises an orifice formed in an electrically conducting material communicating with a vessel for containing the second liquid, means for delivering the first liquid to and through the orifice, 75 means for charging the orifice to a high potential, and a sprayhead for receiving the electrically charged emulsion formed at the orifice and for emitting the emulsion in the form of an electrically charged spray. Conveniently the sprayhead comprises an electrically 80 conducting surface for receiving the electrically charged emulsion, and means for creating a field strength at the surface sufficient to atomise the emulsion therefrom in the form of 85 a fine spray.

The emulsions, being electrostatically charged, are attracted to spray targets and coat them more evenly than uncharged sprays would do. Electrostatic force fields carry the 90 charged particles behind the target, so as to coat all sides of it. The method and apparatus of the invention may be used for spraying paints and like coatings on to structures or articles of manufacture, and (with particular 95 advantage) for spraying pesticides (eg, insecticides, herbicides, fungicides and the like) on to crops of weeds. Conveniently emulsions according to the invention comprise from about 1 to about 10% by weight disperse 100 phase, though higher and lower amounts may be used where appropriate.

A specific embodiment of the invention will now be described with reference to the drawings, in which:

105 *Figure 1* is a vertical cross-section through a spraying device according to the invention adapted to spray an invert emulsion of aqueous herbicide in oil;

Figure 2 is a circuit diagram for the device;

110 *Figure 3* is an alternative circuit diagram for the device.

In Fig. 1, a container 1 of insulating material (glass) is provided with an earthed jacket 13 of conductive material, and with a conduit 115 2 for delivering liquid. In the base of the container 1 is a metallic exit nozzle 3, with a bore of capillary size. Below the container 1, and disposed symmetrically around the outlet of nozzle 3, is a metal ring 4 connected (as shown in Fig. 2) to earth 19. Centrally within the upper part of the container 1 is a second container 5 of insulating material (glass) fed by a liquid delivering conduit 6. In the base of container 5 is a second metallic exit nozzle 7, 120 of capillary dimensions. Both nozzles 3 and 7 are connected (as shown in Fig. 2) to a source of high potential 8 (0-20 kilovolts, 200 microamp module) via a switch 9. Below the container 5, within the container 1, and symmetrically disposed around the outlet of the 130

nozzle 7, is a second earthed metal ring 10. The nozzle 3 may be closed by an exterior cap or bung 12.

In operation, a hydrocarbon oil 11 is passed
5 into the container 1 from the conduit 2 until
the level of oil 11 is above the base of
container 5. An aqueous solution containing
7% by weight of paraquat dichloride is passed
through conduit 6 into container 5. Capillary-
10 sized droplets of the aqueous solution pass
out through nozzle 7 and sink through the oil
11. The switch 9 is then closed, applying a
voltage of the order of 15 kilovolts to the
nozzles 7 and 3. At once the passage of
15 capillary-sized droplets into the oil 11 ceases,
and the oil becomes cloudy, indicating the
formation of an emulsion. The liquid in the
container 1 becomes turbulent, exhibiting
negative surface tension due to the electrical
20 charge it carries. The cap 12 is then removed,
and the emulsion (containing about 4%
weight disperse phase) issues from the nozzle
3. The electric field between the nozzle 3 and
the earthed ring 4 causes the emulsion to
25 atomize as fine particles, which pass outwards
and are attracted to suitable targets, eg,
weeds. Meanwhile the flows of oil 11 through
conduit 2 and of aqueous solution through
conduit 6 are adjusted to maintain the levels
30 of liquid in containers 1 and 5 constant.

The particle size of the disperse phase in
the emulsion may be controlled by control of
the field strength at the nozzle 7; eg, by
varying the distance between the nozzle 7 and
35 the ring 10, or, more conveniently, by varying
the applied voltage. The stronger the field the
smaller are the droplets. Similarly, the particle
size of droplets in the atomized emulsion may
be controlled by control of the field strength
40 at the nozzle 3. This may be done by varying
the voltage on the nozzle 3, the position of
the ring 4, or by applying a variable voltage
(positive or negative with respect to the poten-
tial of the nozzle 3) to the ring 4 instead of
45 earthing it.

The same apparatus may be used, if de-
sired, to form an emulsion in which water or
an aqueous solution is the continuous phase
and oil is the disperse phase, by feeding water
50 to container 1 and oil to container 2.

If desired, the nozzle 7 may be charged by
induction, as shown in Fig. 3. If the nozzle 7
is connected to the earth 19, and the source
of potential 8 to ring 10, a strong charge of
55 opposite sign will be induced on nozzle 7 and
liquid passing through will be charged by
contact in the same way as if the nozzle 7
were connected to source of potential 8, ex-
cept that the charge will be of opposite sign.
60 An emulsion will be formed in just the same
way, with the charging current being taken
from earth. This saves current at nozzle 7, but
slightly more is used at nozzle 3, because the
emulsion has to be discharged and recharged
65 in the opposite sense before atomisation. In

any case the power consumption of the device
is not high, and is readily adapted to use in
portable devices powered by dry cells, or even
solar cells. For agricultural spraying, however,
70 it will often be convenient to mount the
device on a vehicle (eg a tractor or aircraft)
and power it from a power source carried on
the vehicle (eg the tractor battery).

If desired, (eg to obtain a greater through-
75 put rate than is normally conveniently avail-
able through electrostatic atomisation) the emul-
sion may be atomised wholly or partly me-
chanically, eg from a pressure nozzle or spin-
ning cup or disc. Generally, however, electro-
80 static atomisation is preferred, with advan-
tages which may include lower energy usage,
apparatus with fewer or no moving parts, and
spray droplets of very regular and controllable
size.

85 CLAIMS

1. A process for forming and spraying a
dilute emulsion of a first liquid in a second
liquid immiscible therewith which comprises
90 passing small amounts of the first liquid into a
body of the second liquid while electrically
charging the first liquid relative to the second
liquid to a potential sufficient to cause emulsi-
fication therein, and atomising the charged
95 emulsion thereby formed.

2. A process as claimed in claim 1
wherein atomisation is effected by passing the
charged emulsion into a region of high electri-
cal field strength.

100 3. A process as claimed in either of claims
1 or 2 wherein the first liquid comprises a
pesticide.

4. Apparatus for carrying out the process
of claim 1 which comprises an orifice formed
105 in an electrically conducting material commu-
nicating with a vessel for containing the sec-
ond liquid, means for delivering the first liquid
to and through the orifice means for charging
the orifice to a high potential and a sprayhead
110 for receiving the electrically charged emulsion
formed at the orifice and for emitting the
emulsion in the form of an electrically charged
spray.

5. Apparatus as claimed in claim 4 in
115 which the sprayhead comprises an electrically
conducting surface with means for creating a
field strength at the surface sufficient to atom-
ise the emulsion therefrom in the form of a
fine spray.

120 6. Apparatus as claimed in claim 5
wherein the means for creating field strength
at the surface comprises an electrode at a
potential different from that of the surface.

7. Apparatus as claimed in claim 6 in
125 which the electrode is earthed.

8. Apparatus as claimed in any of claims
4 to 6 which is provided with an electrode
adjacent the orifice, and at a different poten-
tial therefrom, to intensify the electric field
130 thereat.

9. Apparatus as claimed in claim 8 wherein the electrode adjacent the orifice is earthed.

10. Apparatus as claimed in any of claims 4 to 9 mounted on a vehicle and adapted for agricultural spraying.

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